OPERATION
AND
SERVICE MANUAL
T.O.S. NO. 3

MODEL S-100
PLUG-IN SWEEP OSCILLATOR

INDUSTRIES, INC.

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SERIAL NO. A17667

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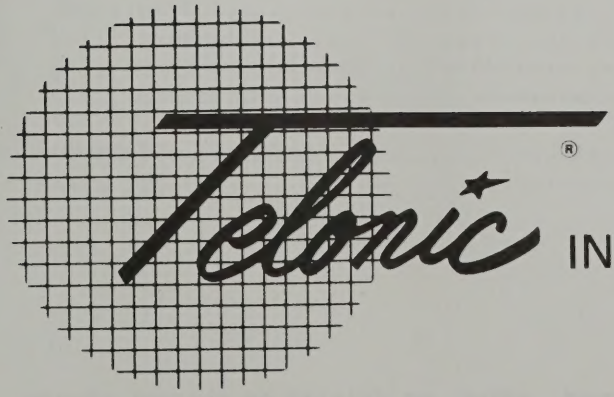

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SECTION I

GENERAL INFORMATION

1-1. SPECIFICATIONS.

1-2. Table 1-1. lists the specifications for the S-100 PLUG-IN SWEEP OSCILLATOR.

TABLE 1-1.

Specifications	
Sweep Oscillator:	
Center Frequency Range -	10 to 250 MHz
Sweep Frequency Range -	10 to 250 MHz
Sweep Width-	200 KHz to 70 MHz
Output Voltage-	0.3 Volts rms
Amplitude Level Variation-	± 1dB maximum
Vernier Attenuation-	1dB maximum
Linearity-	2:1 at full sweep width
Variable Marker:	
Frequency Range:	
Heterodyne Band (Lo)-	0 to 50 MHz
Fundamental Band (Hi)-	50 to 125 MHz
Harmonic Band-	125 to 250 MHz
Accuracy:	
Heterodyne Band-	300 KHz
Fundamental and Harmonic Band-	0.3%
Calibration Marks-	1 MHz

1-3. DESCRIPTION. (Figure 1-1.)

1-4. The S-100 PLUG-IN SWEEP OSCILLATOR is a heterodyne oscillator designed for use with the Telonic SWEEP/SIGNAL GENERATOR CONTROL CHASSIS SM-2000. The S-100 provides adjustable sweep widths of 200 KHz to 70 MHz anywhere within the 10 to 250 MHz band.

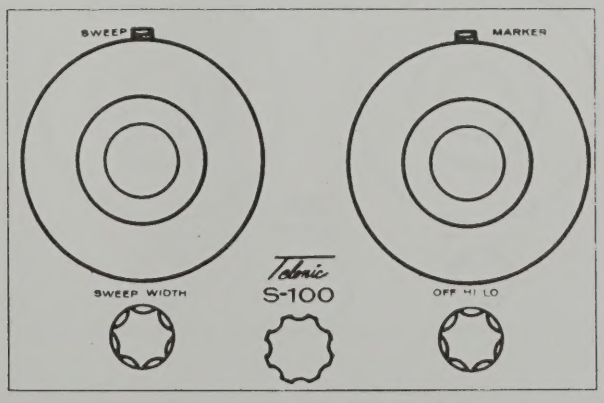

Figure 1-1. S-100 PLUG-IN SWEEP OSCILLATOR

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SECTION II

OPERATING INSTRUCTIONS

2-1. GENERAL.

2-2. This section provides the complete functional control description and operating instructions for the S-100 PLUG-IN SWEEP OSCILLATOR.

2-3. CONTROL PANEL DESCRIPTION. (See figure 2-1.)

2-4. FRONT PANEL. Table 2-1 provides a complete functional description of all Front Panel Controls.

TABLE 2-1.

Front Panel Control	Functional Description
SWEEP-	Provides a calibrated control to vary the center frequency between 10 and 250 MHz.
MARKER-	Provides a calibrated control to vary the marker frequency from 0 to 125 MHz.
OFF-HI-LO-	Provides control to select the proper operating band for the variable marker.
SWEEP WIDTH-	Provides control to vary the Sweep Width between 200 KHz and 70 MHz.

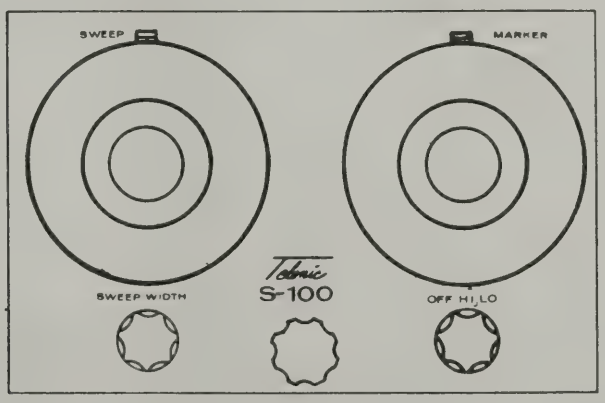


Figure 2-1. Front Panel Controls

2-5. REAR PANEL. (See figure 2-2.) Table 2-2. provides a complete functional description of all rear panel connectors.

TABLE 2-2.

Rear Panel Connector Functional Description	
P601-	Provides electrical connection to the SM-2000 Control Chassis.
RF-	RF output BNC connector.
MARKER-	Variable Marker output BNC connector.

2-6. PRE-OPERATION.

2-7. The following pre-operation procedure must be performed before operating the S-100 PLUG-IN SWEEP OSCILLATOR.

a. Insert the S-100 in the SM-2000 SWEEP/SIGNAL GENERATOR CONTROL CHASSIS and tighten fastening rod.

CAUTION

Ensure SM-2000 POWER-ON switch is in the Off position before inserting the S-100

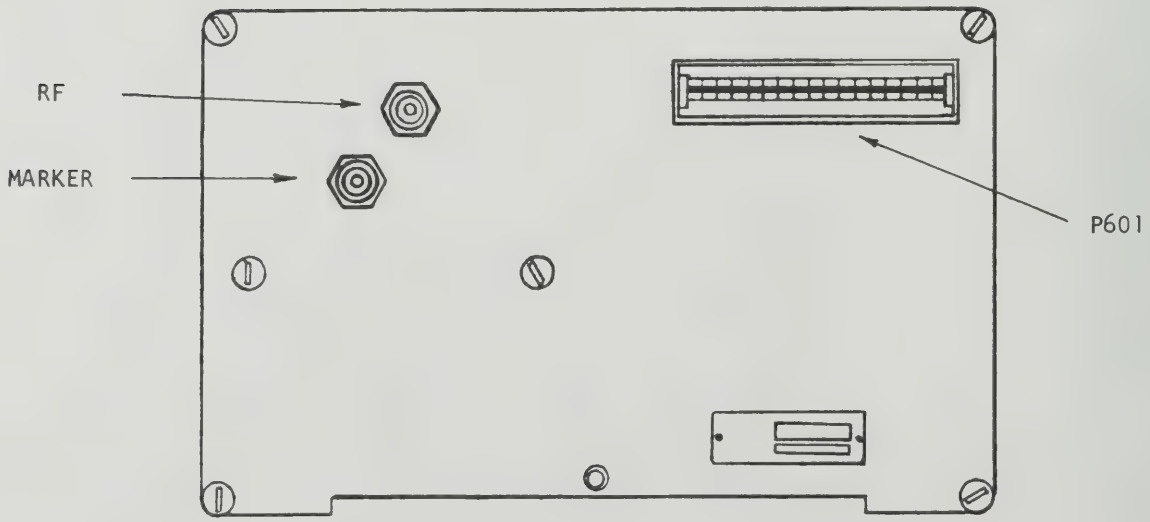


Figure 2-2. Rear Panel Connectors

b. Connect the SM-2000 to the unit under test as shown in figure 2-3.

2-8. OPERATING PROCEDURE.

a. Refer to the SM-2000 SWEEP/SIGNAL GENERATOR CONTROL CHASSIS INSTRUCTION MANUAL for operating procedure.

CAUTION

Ensure MAX-LEVEL LIMIT control is set to proper RF level.

b. Adjust the SWEEP, MARKER and SWEEP WIDTH controls on the S-100 as required.

NOTE

The second harmonic of the Variable Markers Fundamental band frequencies will provide the proper Harmonic band frequency.

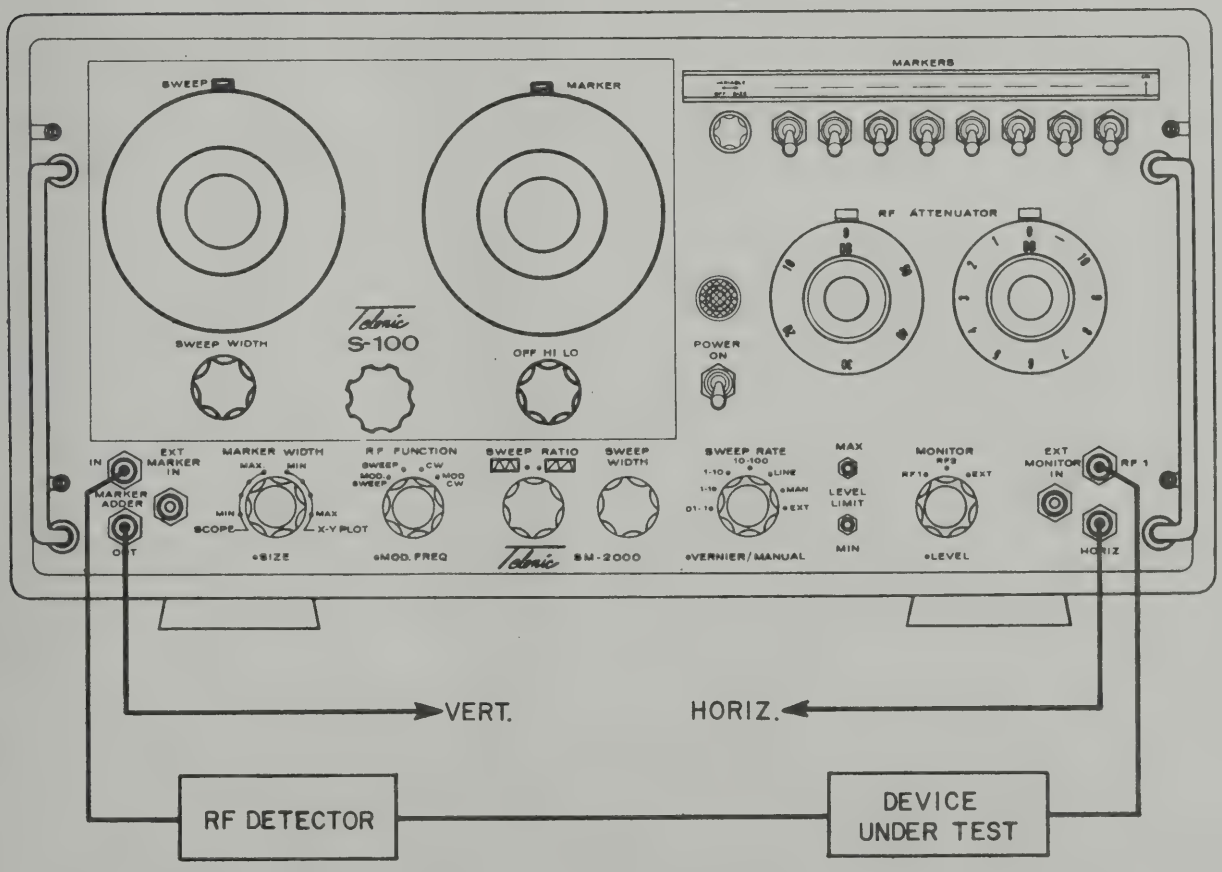


Figure 2-3. Typical Test Connection

SECTION III

PRINCIPLES OF OPERATION

3-1. GENERAL.

3-2. This section provides a brief description of the major circuits of the S-100 PLUG-IN SWEEP OSCILLATOR.

3-3. SWEEP OSCILLATOR.

3-4. The SM-2000 SWEEP/SIGNAL GENERATOR CONTROL CHASSIS provides a leveled B+ signal through connector P601 pin 31 to the S-100. The B+ is applied to the plates of Tunable Oscillator V801 and Sweep Oscillator V802 through RF chokes L806 and L817. B+ RF bypassing is provided by feed-thru capacitors C802, C811 and C814. The 6.3 VAC filament voltage is provided through connector P601 pin 9 and is passed through feed-thru capacitor C803 to the V801 filament chokes L807 and L808. The 6.4 VDC filament voltage is passed through feed-thru capacitors C810, C813, C817 and C818. Filament regulator adjustment is provided by variable resistor R611.

3-5. The tuned fixed frequency circuit is composed of a Colpitts oscillator (V801) with a parallel resonant line. The oscillator is tuned by means of a front panel control (C801) in conjunction with fixed tuned line inductors L801 and L802. Grid bias is provided by resistor R801 through RF choke L804. The oscillator output is coupled through pickup coil L803 to mixer diodes CR801 and CR802.

3-6. The fixed sweep frequency circuit made up of a Colpitts oscillator V802 is tuned in a manner identical to the tuned sweep frequency circuit described in paragraph 3-5; tuning capacitance is provided by varicap CR803 and its associated circuit. Varicap drive voltage is provided by cathode-follower V601 through RF choke L815 to varicap diode CR803. The dc ground return path is provided through RF choke L812. Dc blocking of the varicap drive voltage is provided by capacitors C805 and C806. Capacitor C815 provides RF bypass. The dc grid bias path to oscillator V802 is provided through choke L813 and capacitor C808.

3-7. The output of V802 is coupled through series tuned choke L814 to mixer diodes CR801 and CR802. The mixer circuit output is fed through coupling capacitor C804 to lowpass filter Z801, which will pass 10 to 250 MHz, and peaking capacitor C816. The output of Z801 is fed directly to the SM-2000 through the rear panel RF Output BNC connector.

3-8. The Sweep drive voltage is fed to cathode-follower V601 and its associated circuitry directly from the SM-2000 Control Chassis. A fixed reference voltage for the minimum Sweep Width is provided by zener diode CR601. Diode CR602 and voltage divider R607/R608 limit the varicap voltage. The varactor drive voltage amplitude is varied by the means of variable resistor R602 (front panel Sweep Width control). Maximum Sweep Width adjustment is provided by variable resistor R601.

3-9. VARIABLE MARKER.

3-10. FUNDAMENTAL BAND (HI).

3-11. Series fed Hartley oscillator V901A operates as a variable oscillator in the 50 to 125 MHz range. The tank circuit is composed of inductor L901A and variable capacitor C901 and front panel control (C902). Grid leak bias is provided by capacitor C905 and resistor R901. RF choke L903 and C907 provide a RF bypass and decoupling path for the grounded plate operation. The RF output is link coupled by inductor L901B through resistor R906 and capacitor C908 to the marker mixer in the SM-2000.

3-12. HETERODYNE BAND (LO).

3-13. Series fed Colpitts oscillator V901B and 60 MHz crystal Y901 heterodyne the Fundamental band oscillator during Heterodyne band operation.

3-14. The oscillator tank circuit is formed by variable inductor L902A and capacitors C903 and C904. Inductor L902A provides the proper plate load resonance to V901B. Capacitors C903, C904 and inductor L902A provide the 180 degree phase shift required for proper operation of the oscillator. The feedback from the plate to grid is controlled by the 60 MHz crystal which feeds the proper operating signal to the grid of V901B. Grid leak bias is provided by resistor R905 and capacitor C906. Isolation resistor R904 prevents over loading of the grid by test instruments used at the test point. Link coupling is provided for the RF output signal through inductor L902B, resistor R907 and capacitor C908 to the monitor mixer in the SM-2000. Impedance matching at the RF output is provided by resistor R908.

3-15. Front Panel switch S901 permits selection of the desired marker band operation. Resistor R902 and capacitors C909 through C912 provide RF decoupling and bypass to prevent RF leakage outside the oscillator enclosure.

SECTION IV

MAINTENANCE

4-1. GENERAL.

4-2. This section provides complete information for the troubleshooting and maintenance of the S-100 PLUG-IN SWEEP OSCILLATOR.

4-3. REQUIRED TEST EQUIPMENT.

4-4. The following test equipment will be required to perform maintenance on the S-100.

a.	Sweep/Signal Generator Control Chassis	Telonic SM-2000 or equivalent
b.	Oscilloscope	Analab 1100 or equivalent
c.	Volt-Ohm-Milliammeter	Simpson 260 or equivalent
d.	RF Detector	Telonic XD-4A or equivalent
e.	0.1 MHz Crystal Marker	Telonic CDH-0.1 or equivalent
f.	10.0 MHz Crystal Marker	Telonic CDH-10.0 or equivalent

4-5. PERFORMANCE CHECK.

4-6. This performance check may be used as a routine maintenance procedure or as an incoming inspection to verify the performance of the S-100.

4-7. INITIAL SETUP.

a. Plug the S-100 into the SM-2000 Control Chassis.

CAUTION

Ensure the SM-2000 POWER-ON switch is in the Off position.

b. Plug the 0.1 MHz, and 10.0 MHz crystal markers into the Control Chassis.

c. Connect the equipment as shown in figure 4-1.

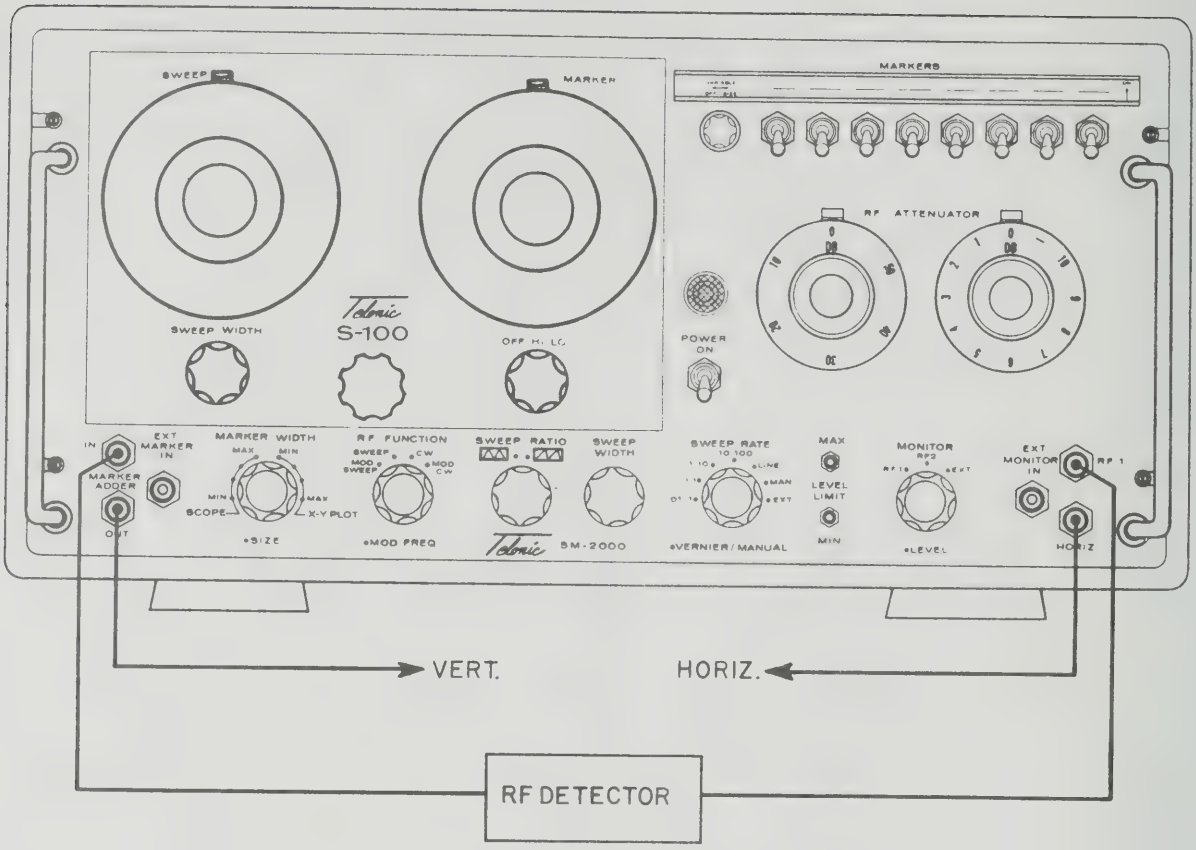


Figure 4-1. Test Connections

4-8. Set the controls on the Control Chassis to the following positions:

a. 10 MHz Marker - ON

b. Marker Width - SCOPE MAX

c. Size - mid position

d. RF Function - SWEEP

e. Sweep Ratio - ⊠

f. Sweep Rate - LINE

g. Max Level Limit - fully clockwise

h. Min Level Limit - fully counter-clockwise

i. Monitor - RF 1

j. Level - fully clockwise

k. RF Attenuators - 0 dB

4-9. Set the POWER-ON switch on the Control Chassis to the ON position.

NOTE

Allow a twenty minute warmup period.

4-10. SWEEP CENTER FREQUENCY CALIBRATION.

a. Adjust the oscilloscope controls as follows:

(1)	A Input Vertical Gain -	0.1 mv/cm
(2)	A Pre-Amp. -	-DC
(3)	Trigger Source -	LINE
(4)	Sweep Mode -	OFF
(5)	B Input Horizontal Gain -	1.0 v/cm
(6)	B Pre-Amp. -	+DC

b. Set the SWEEP WIDTH control on the front panel of the S-100 to the fully clockwise position.

c. Rotate the SWEEP dial from 0 to 250 MHz and observe the amplitude on the oscilloscope.

d. The amplitude of the output should be 0.30v or greater throughout the entire sweep range of 10 to 250 MHz.

4-11. SWEEP WIDTH TEST.

a. With the controls set as above, observe the width of the sweep. The maximum width should be 70 MHz and may be verified by counting the 10 MHz birdies.

b. Set the 10.0 MHz MARKER switch to the Off position.

c. Adjust the SWEEP WIDTH control on the S-100 fully counterclockwise.

d. Set the 0.1 MHz MARKER switch on the SM-2000 to the ON position.

e. Set the LEVEL control for a detected output of 0.3 volts.

f. Rotate the SWEEP dial through the range from 10 MHz to 250 MHz and observe the sweep width.

g. The sweep width should be equal to or less than 0.2 MHz throughout the entire range of 10 to 250 MHz.

4-12. FM DEVIATION TEST.

a. Set the 0.1 MHz MARKER switch to the Off position.

b. Set the 10.0 MHz MARKER switch to the ON position.

c. Adjust the oscilloscope for a horizontal deflection of 10 cm.

d. Center the oscilloscope display on the 100 MHz marker birdy.

e. Set the 10.0 MHz MARKER switch to the Off position and the 0.1 MHz MARKER switch to the ON position.

f. Adjust the SWEEP WIDTH control for a 0.20 MHz sweep width.

g. Center a birdy on the oscilloscope display.

h. Observe the horizontal movement of the birdy. It should be less than 2 cm per second.

i. Repeat steps a. through h. with the display centered in turn on the 150 MHz and 200 MHz markers.

4-13. RF OUTPUT TEST.

a. Adjust the LEVEL control for an output amplitude of 0.3v on the oscilloscope.

b. Set the SWEEP WIDTH control on the S-100 to the fully clockwise position.

c. Rotate the SWEEP dial throughout the range of 10 to 250 MHz and observe the amplitude of the output.

d. The difference between the maximum and minimum amplitudes should be less than 0.074 volts.

e. Adjust the LEVEL control for an output of 0.267 volts.

f. Repeat steps b. through e. above.

4-14. LINEARITY TEST.

a. Adjust the LEVEL control for an output of 0.3v on the oscilloscope.

b. Set the 0.1 MHz MARKER switch to the Off position.

c. Adjust the SWEEP WIDTH control on the S-100 for a sweep width of 70.0 MHz.

d. Linearity is calculated by measuring the distance between the 10 MHz markers and dividing the widest spacing by the narrowest spacing.

e. Check the linearity over the range from 10 MHz to 250 MHz in 70 MHz segments.

f. The linearity should be less than 2:1 over the entire range of 10 MHz to 250 MHz.

4-15. VARIABLE MARKER TEST.

a. Set the Marker Band OFF-HI-LO switch to the LO position.

b. Rotate the VARIABLE SIZE marker control on the SM-2000 to the fully clockwise position.

c. Rotate the MARKER dial on the S-100 fully counterclockwise.

d. Adjust the SWEEP dial until the first five or more fixed birdies (0 to 50 MHz) are centered on the oscilloscope.

e. Rotate the MARKER dial clockwise. The variable marker birdy should start at 0 MHz and move across the oscilloscope to the right.

f. When the variable marker birdy is centered on the 50 MHz fixed marker, stop rotating the MARKER dial.

g. Adjust the SWEEP dial to move the 50 MHz marker to the left side of the oscilloscope.

h. Set the Marker Band OFF-HI-LO control to the HI position. Little change in the fundamental marker at 50 MHz should be evident.

i. Continue rotating the MARKER dial clockwise. The variable marker birdy should continue moving to the right to 250 MHz.

4-16. VARIABLE MARKER AMPLITUDE.

a. Set the SWEEP WIDTH and VARIABLE SIZE controls on the control chassis to the fully clockwise position.

b. Set the Marker Band OFF-HI-LO switch to the LO position.

c. Rotate the MARKER dial to the 20 MHz position.

d. The amplitude of the variable marker birdy should be greater than 5 volts peak-to-peak.

4-17. DIAL CALIBRATION CHECK.

a. Set the 10.0 MHz MARKER switch to the ON position.

b. Adjust the SWEEP WIDTH control on the S-100 for a sweep width of 20 MHz.

c. Set the SWEEP dial to the 0 MHz position.

d. The 0 MHz birdy should be centered on the oscilloscope.

e. Check the calibration of the SWEEP dial in 20 MHz increments over the entire range of 0 to 250 MHz.

f. Check the calibration of the MARKER dial in the same manner as above.

4-18. TROUBLESHOOTING.

4-19. Refer to table 4-1 for complete troubleshooting procedures; ensure that the SM-2000 SWEEP/SIGNAL GENERATOR CONTROL CHASSIS is operating properly before starting the troubleshooting procedure.

TABLE 4-1.

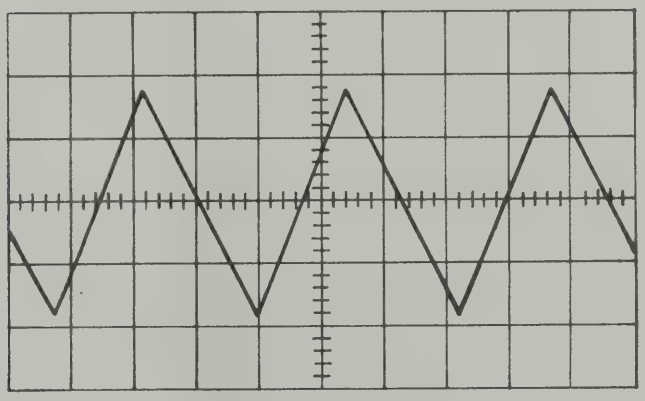
Troubleshooting Chart				
Proc No.	Trouble	Normal Indication	Test Point	Probable Cause of Failure
1.	Improperly Leveled or loss of sweep Output	Leveled sweep Output	SM-2000 RF 1 output BNC connector	1. Check sweep oscillator tube V801 and V802 and associated circuits. 2. Check Leveler V304 and associated circuits in the SM-2000 Control Chassis 3. Adjust Filament regulator potentiometer as specified in paragraph 4-23.
2.	Improper sweep drive	10-250 MHz birdy	SM-2000 RF 1 output BNC connector	1. Check Connector P601. 2. Check Varactor Drive tube V601 and associated circuits.
3.	Improper variable marker output	10-250 MHz	SM-2000 Output BNC connector	1. Check Connector P601. 2. Check Marker oscillator tube V901 and associated circuitry.
4.	Improper sweep sample	10-250 MHz	J206	1. Check J206 BNC connector and coaxial cable.
5.	Insufficient Maximum sweep width	70 MHz	SM-2000 RF 1 output BNC connector	1. Check Varactor CR803. 2. Check Varactor Drive tube V601 and associated circuits.

4-20. WAVEFORM. Figure 4-2 provides a typical waveform present at the output of the sweep oscillator.

4-21. Adjust the SM-2000 Controls as follows:

a. SWEEP RATE -	LINE
b. RF FUNCTION -	MOD. SWEEP
c. MONITOR -	RF 1
d. LEVEL -	Maximum
e. SWEEP WIDTH -	70 MHz
f. MARKERS -	Off
g. POWER -	ON
h. SWEEP RATIO -	equal
i. S-100 SWEEP FREQUENCY -	250 MHz

4-22. Adjust the oscilloscope as indicated under the waveform.



TEST POINT 1

Scale Level 80V
Use 10X Probe
Vert. Sensitivity 2V/cm
Horizontal Sweep 5 msec/cm

Figure 4-2. Typical Waveform

4-23. Filament Regulator Adjustment.

4-24. Connect volt-ohm-meter red lead to Test Point (3) and the black lead to Test Point (2) .

4-25. Set the meter to the 10 volt + DC scale.

4-26. Rotate the Filament Regulator potentiometer until 6.4 ±0.1 VDC is indicated on the meter.

SECTION V

PARTS LIST

5-1. GENERAL.

5-2. This section provides the complete electrical parts list and component numbering system for the S-100 PLUG-IN SWEEP OSCILLATOR.

5-3. COMPONENT NUMBERING SYSTEM. Table 5-1 specified the numbering sequence used for each circuit in the S-100.

TABLE 5-1.

Numbering Sequence	
600-699	Varactor drive
800-899	Sweep oscillator
900-999	Variable marker oscillator

5-4. ELECTRICAL PARTS LIST. Table 5-2 provides the complete electrical parts list for the S-100.

TABLE 5-2.

Electrical Parts List		
Circuit Reference No.	Description	Telonic Part No.
C601	CFM (SC)	
C602	CFE, 30µf, 150 VDCW	C-306
C603	CFE, 500µf, 50 VDCW	C-347
C801	CVA	Not assigned
C802	CFCF, 1000pf, 500V	MC-711
C803	Same as C802	
C804	CFM, 0.01 µf, 500V	C-20
C805	CFCF, 1000pf, 500V	C-110
C806	Same as C805	
C807	CFC, 0.18pf, 500V	C-31
C808	CFCF, 470pf, 500V	C-125
C809	Not Assigned	
C810	Same as C802	
C811	Same as C802	
C812	Not Assigned	
C813	Same as C802	
C814	Same as C802	
C815	Same as C802	
C816	CFM, 10pf, 500V	MC-720

TABLE 5-2.(Cont)

Circuit Reference No.	Description	Telonic Part No.
C817	Same as C802	
C818	Same as C802	
C901	CVG, 0.7-12pf	C-414
C902	CVA, 100pf max	C-441
C903	CFM, 33pf, ±10%, 500V	MC-705
C904	CFC, 7pf, ±5%, 1000V	C-5
C905	Same as C903	
C906	CFM, 1000pf, 500V	MC-708
C907	Same as C906	
C908	Same as C906	
C909	Same as C802	
C910	Same as C802	
C911	Same as C802	
C912	Same as C802	
CR601	DS, JAN/1N3040B	MC-303
CR602	DS, USN/1N3190	MC-302
CR603	Same as CR602	
CR604	DS, JAN/1N538	MC-306
CR605	Same as CR604	
CR606	Same as CR604	
CR607	Same as CR604	
CR608	DS, JAN/1N277	MC-305
CR609	DS, JAN/1N753A	MC-307
CR801	DS, JAN/1N25A	MC-304
CR802	Same as CR801	
CR803	DS, VA-313	D-43
J901	RJ, UG-625/U	J-7
L801	IF, (SC)	Not assigned
L802	IF, (SC)	Not assigned
L803	IF, (SC)	Not assigned
L804	IF, (SC)	Not assigned
L805	IF, 2.2μH	L-100
L806	IF, (SC)	
L807	IF, 1.0μH	L-102
L808	IF, (SC)	Not assigned
L809	Not assigned	
L810	IF, (SC)	Not assigned
L811	IF, (SC)	Not assigned
L812	IF, 0.68μf	L-103
L813	Same as L812	
L814	IF, (SC)	Not assigned
L815	Same as L812	
L816	Same as L807	
L817	Same as L816	

TABLE 5-2. (Cont)

Circuit Reference No.	Description	Telonic Part No.
L901	IV, assembly	LX-4**
L902	IV, assembly	LX-4**
L903	IF, 2.2μH	MC-500
L904	Same as L903	
P801	PC, UG-88C/U	J-13
P901	Same as P801	
P902	PC, 4961-1	J-27
Q601	TR JAN/2N297A	MC-800
R601	RVC, 1MΩ, ±20%, 2W	R-781
R602	RVC, 1MΩ, ±30%, 2W	R-786
R603	RFM, 47.5KΩ, ±1%, 1/2W	MC-103
R604	RMF, 12.1KΩ, ±1%, 1/2W	MC-115
R605	RMF, 3.32KΩ, ±1%, 1/2W	MC-116
R606	RMF, 121KΩ, ±1%, 1/2W	MC-117
R607	RMF, 26.7KΩ, ±1%, 1/2W	MC-110
R608	RMF, 12.1KΩ, ±1%, 1/2W	MC-115
R609	Same as R607	
R610	Same as R607	
R611	RVC, 1.5KΩ, ±10%, 2W	MC-156
R612	RFW, 10Ω, ±5%, 5W	R-411
R613	RFC, 180Ω, ±10%, 2W	R-333
R614	RFC, 2.2KΩ, ±5%, 2W	R-325
R801	RMF, 10KΩ, ±1%, 1/2W	MC-150
R901	RMF, 10KΩ, ±1%, 1/2W	MC-102
R902	RMF, 4.75KΩ, ±1%, 1/2W	MC-120
R903	Same as R801	
R904	RMF, 56.2KΩ, ±1%, 1/2W	MC-121
R905	Same as R607	
R906	RMF, 21.5Ω, ±1%, 1/2W	MC-152
R907	RMF, 332Ω, ±1%, 1/2W	MC-119
R908	Same as R907	
S901	Switch, wafer, 2 pole, 3 position	SW-46
V601	TE, 12AU7	VT-11
V801	TE, 6DZ4	VT-51
V802	TE, 8627	VT-63
V901	TE, 6DJ8	MC-604
Y901	Crystal, 60 MHz	X-2-60
Z801	Filter Assy.	Not assigned

** Part number for coil form only.

ABBREVIATION CODE

CFC	Capacitor, fixed, ceramic
CFCF	Capacitor, fixed, ceramic feed-thru
CFE	Capacitor, fixed, electrolytic
CFM	Capacitor, fixed, mica
CVA	Capacitor, variable, air-dielectric
CVG	Capacitor, variable, glass-dielectric
DS	Diode, semiconductor
IF	Inductor, fixed
IV	Inductor, variable
PC	Plug, cable
RMF	Resistor, metal film
RVC	Resistor, variable, composition
RFW	Resistor, fixed, wirewound
RJ	Receptacle, jack
SC	Subject to change
TE	Tube, electron
TR	Transistor

SECTION VI

SCHEMATIC DIAGRAMS

6-1. GENERAL.

6-2. This section provides the complete set of schematic diagrams required for maintenance of the S-100 PLUG-IN SWEEP OSCILLATOR.

6-3. The following schematics are included in this manual:

a.	Varactor Drive	Figure 6-1
b.	Sweep Oscillator	Figure 6-2
c.	Variable Marker Oscillator	Figure 6-3

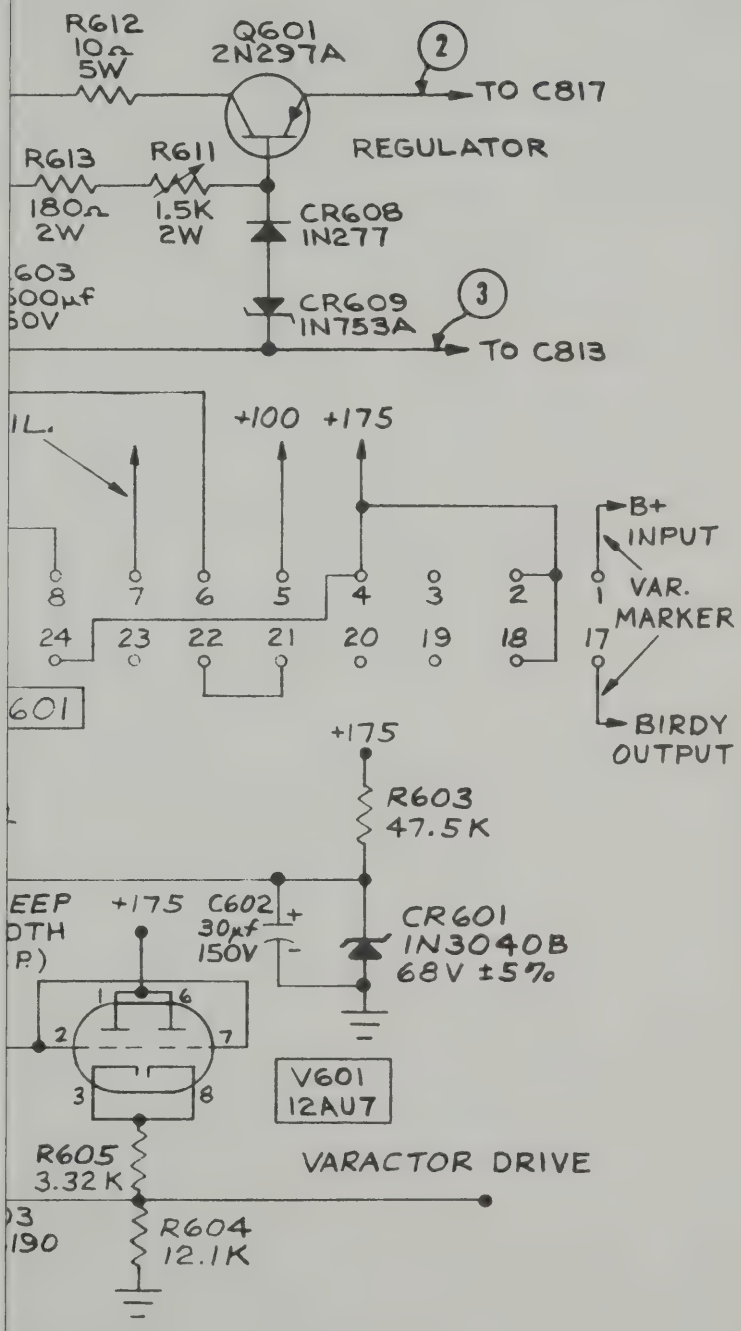
6-4. All resistors are 1/2 watt, ± 1% and are shown in ohms (Ω) unless otherwise specified.

6-5. All capacitors are shown in picofarads (pf) unless otherwise specified.

6-6. All coils are shown in microhenries (μH) unless otherwise specified.

6-7. All starred (*) values are subject to change.

6-8. Test point locations corresponding to the waveforms in Section IV are indicated.



Varactor Drive

Figure 6-1
6-3/6-4

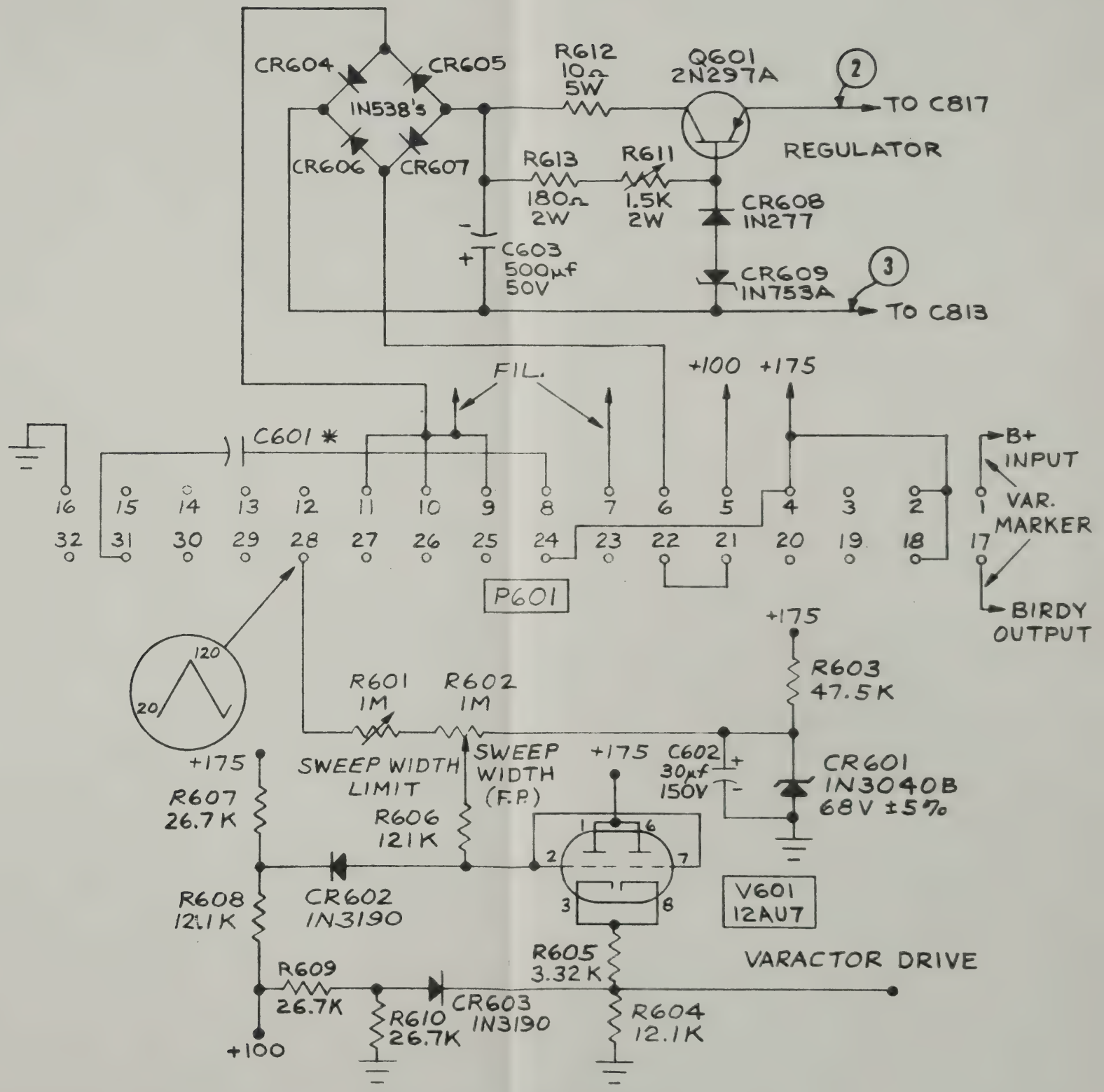
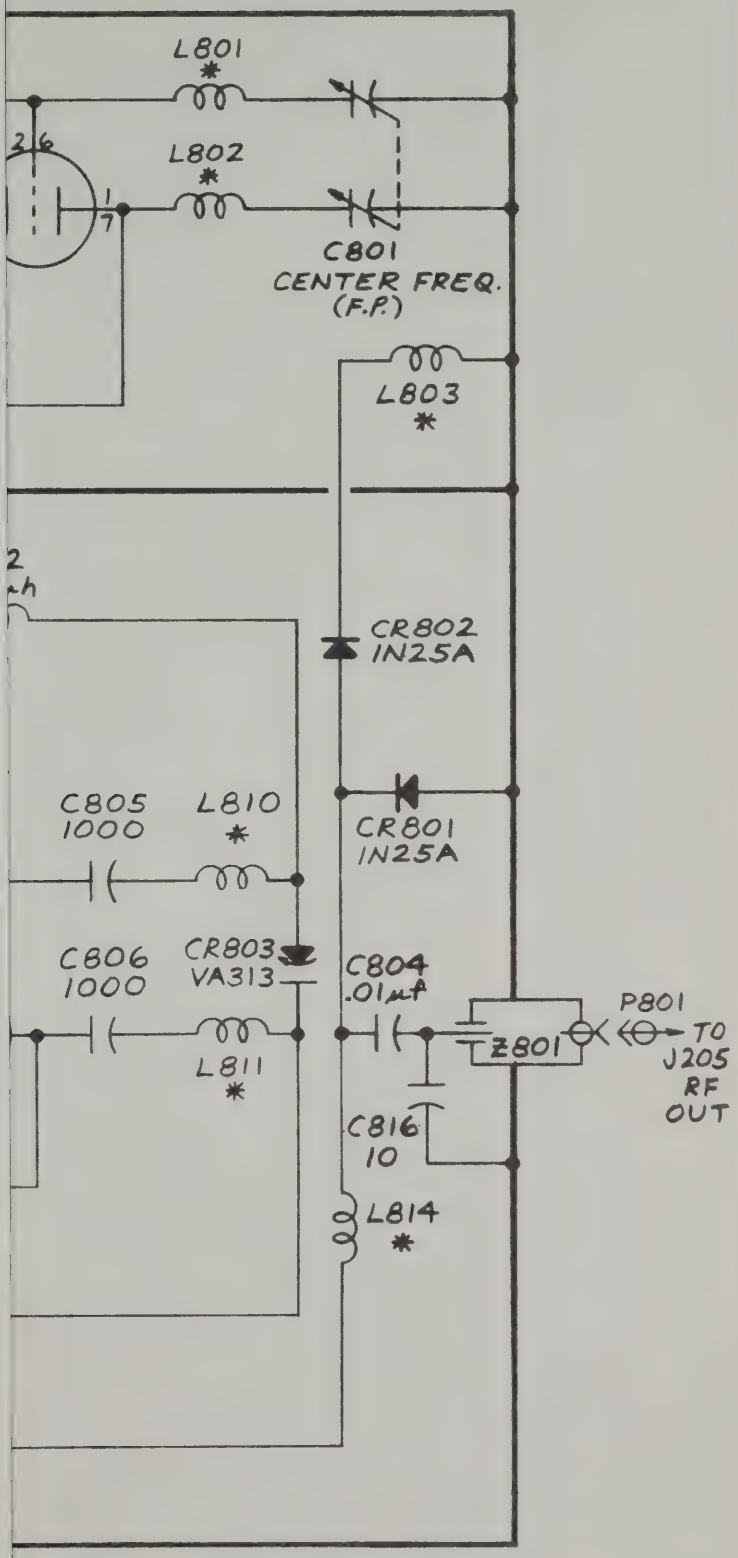


Figure 6-1. Varactor Drive



Sweep Oscillator

Figure 6-2
6-5/6-6

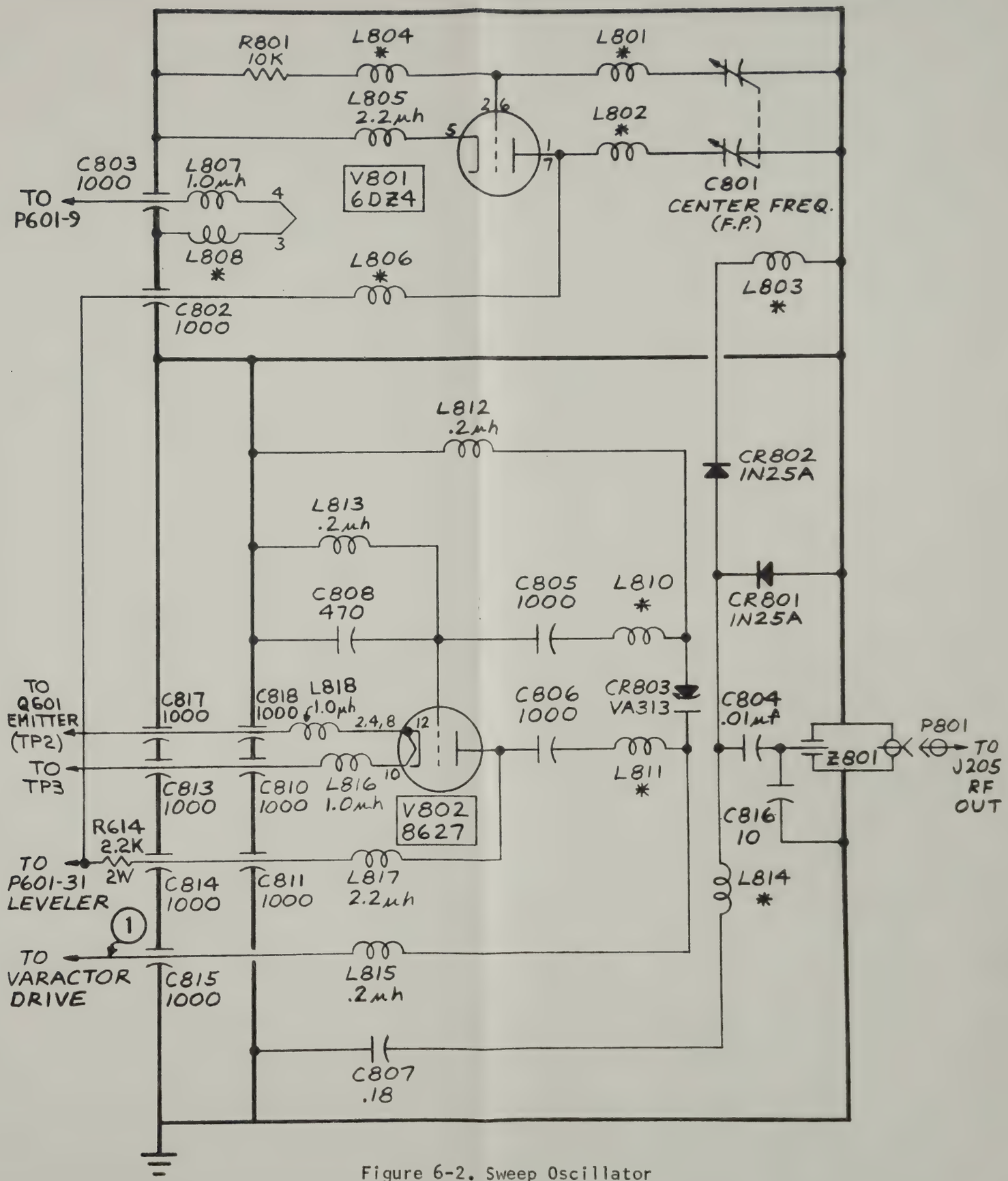
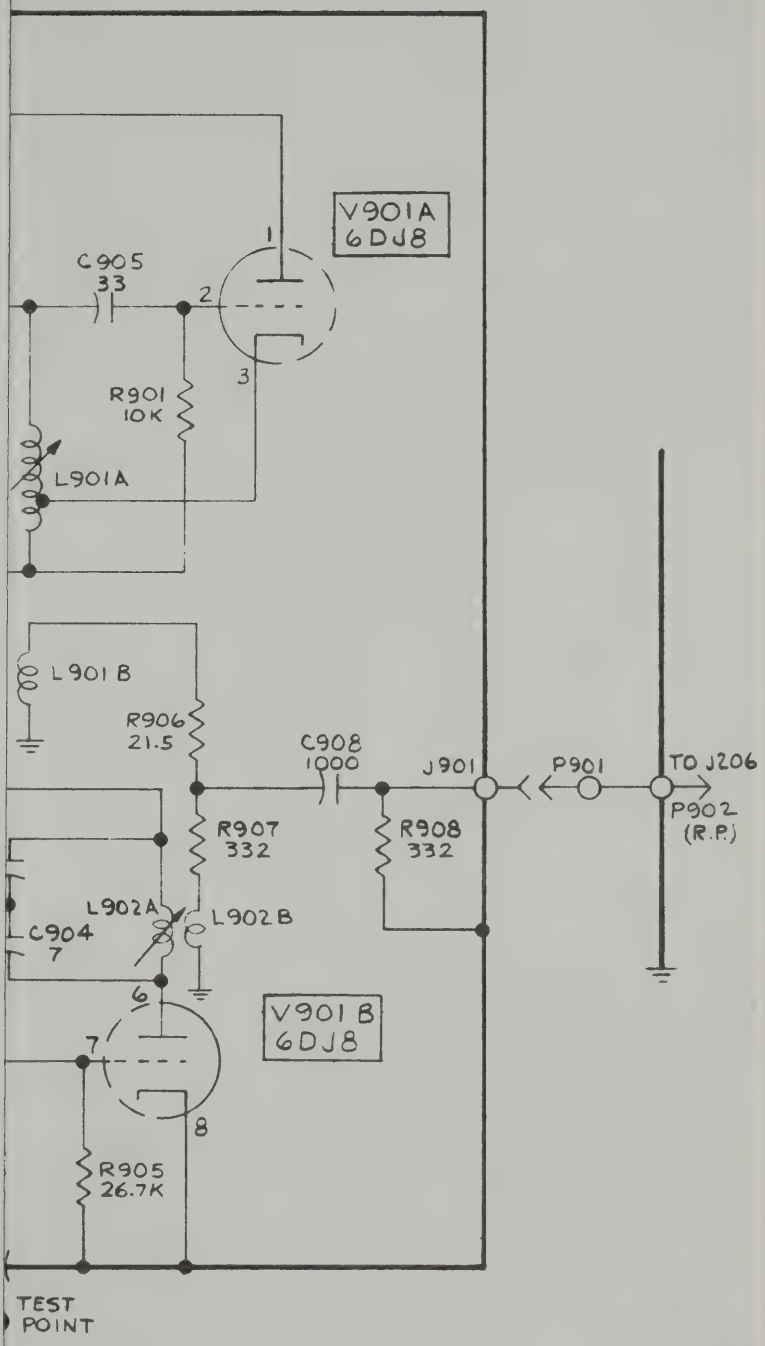


Figure 6-2. Sweep Oscillator



riable Marker Oscillator

Figure 6-3
6-7/6-8

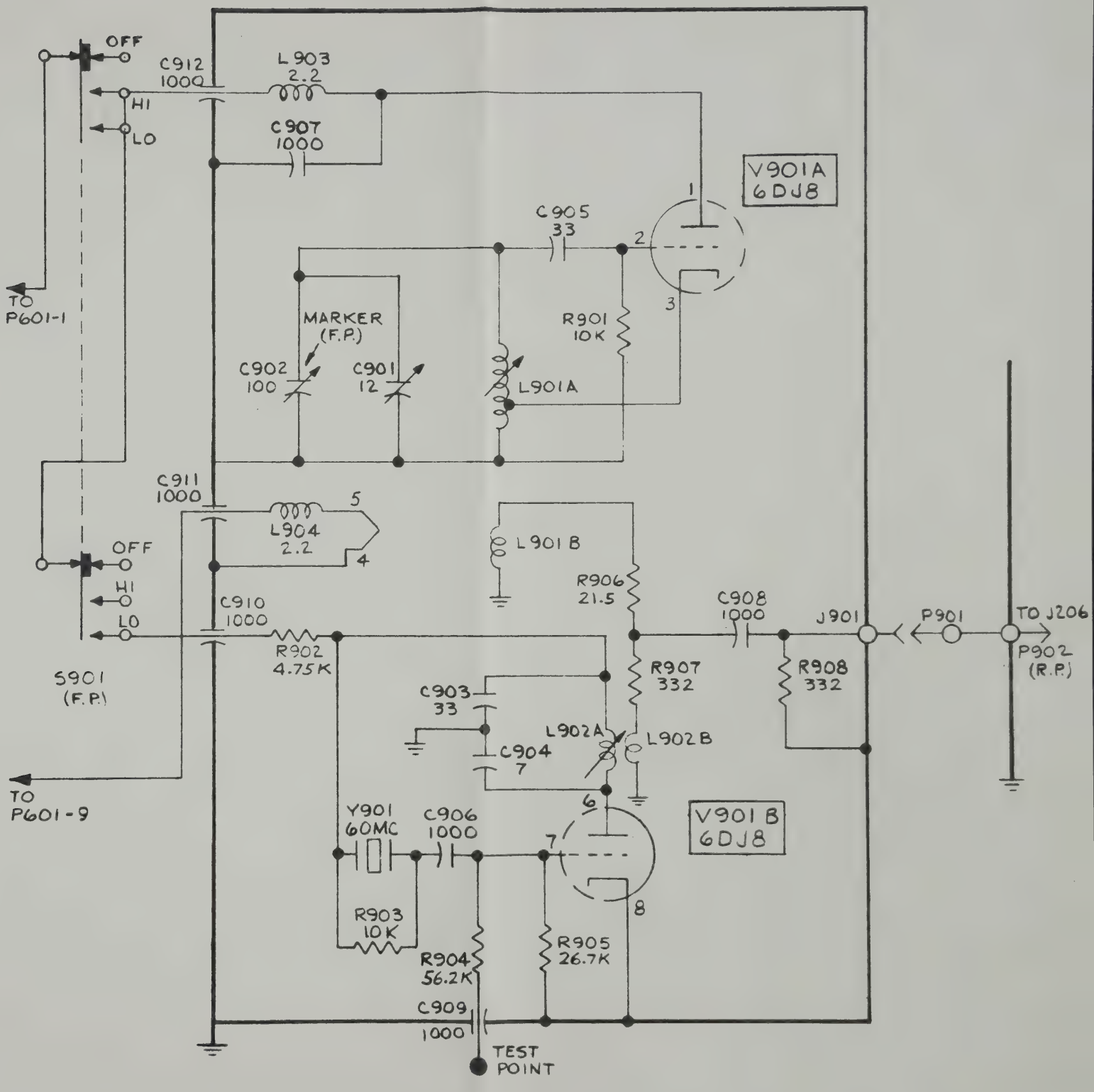


Figure 6-3. Variable Marker Oscillator